

1    WHAT IS CLAIMED IS:

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1        1.     A control system for processing sampled servo data in a disk drive, the control  
2    system comprising:

3                a microprocessor for executing firmware code; and  
4                an accelerator circuit for performing operations on the sampled servo data while  
5    the microprocessor is executing the firmware code, the accelerator circuit comprising  
6                a position error signal (PES) calculator circuit for calculating a PES value  
7    based on the sampled servo data; and  
8                a write unsafe (WUS) estimator responsive to the calculated PES value  
9    and to a WUS limit parameter, the WUS estimator further for signaling the  
10    microprocessor when the calculated PES value exceeds the WUS limit parameter.

1        2.     A control system for processing sampled servo data as defined in claim 1, further  
2    comprising a bus for transmitting the WUS limit parameter from the microprocessor to the  
3    accelerator circuit.

1        3.     A control system for processing sampled servo data as defined in claim 1, wherein  
2    the accelerator circuit further comprises a WUS limit register for storing the WUS limit  
3    parameter.

1        4.     A control system for processing sampled servo data as defined in claim 1, wherein  
2    the accelerator circuit further comprises a PES register for storing the calculated PES value.

1        5.     A control system for processing sampled servo data as defined in claim 1, wherein  
2    the PES value is further based on a parameter stored in a parameter register.

1        6.     A control system for processing sampled servo data as defined in claim 1, wherein  
2    the servo processing accelerator circuit has a plurality of multipliers that may simultaneously  
3    perform parallel calculations.

1       7. A control system for processing data from sampled servo wedges for positioning a  
2 transducer head in a disk drive, the control system comprising:  
3              a microprocessor for executing firmware code; and  
4              a servo processing accelerator circuit for executing servo processing functions  
5 while the microprocessor is executing the firmware code, the servo processing accelerator circuit  
6 comprising  
7              a position error signal (PES) calculator circuit for calculating a stream of  
8 PES values based on data read from the sampled servo wedges;  
9              a servo-loop compensator for processing the stream of PES values and  
10          generating a stream of control effort values for positioning the transducer head during a  
11          track following operation.

1       8. A control system for processing data from sampled servo wedges as defined in  
2 claim 7, wherein the PES values are further based on parameters stored in corresponding  
3 parameter registers.

1       9. A control system for processing data from sampled servo wedges as defined in  
2 claim 7, wherein the servo processing accelerator circuit has a plurality of multipliers that may  
3 simultaneously perform parallel calculations.

1       10. A control system for processing data from sampled servo wedges for positioning a  
2 transducer head in a disk drive, the control system comprising:  
3              a microprocessor for executing firmware code; and  
4              a servo processing accelerator circuit for executing servo processing functions  
5 while the microprocessor is executing the firmware code, the servo processing accelerator circuit  
6 including a servo-loop compensator for receiving a stream of PES values based on data read  
7 from the sampled servo wedges and generating a stream of control effort values based on the  
8 stream of PES values for positioning the transducer head during a track following operation.

1       11. A control system for processing data from sampled servo wedges as defined in  
2 claim 10, wherein the PES values are further based on parameters stored in corresponding  
3 parameter registers.

1        12. A control system for processing data from sampled servo wedges as defined in  
2 claim 10, wherein the servo processing accelerator circuit has a plurality of multipliers that may  
3 simultaneously perform parallel calculations.

1        13. A magnetic disk drive, comprising:  
2              a head disk assembly (HDA) including  
3                  a rotating magnetic disk having distributed position information in a  
4                  plurality of uniformly spaced-apart servo wedges for defining data storage tracks,  
5                  an actuator for positioning a transducer head in response to a control effort  
6                  signal, the transducer head for periodically reading the distributed position information  
7                  from the servo wedges and reading data from the data storage tracks; and  
8                  a control system having  
9                      an accelerator circuit for implementing a first sampled servo controller for  
10                  periodically adjusting, only during a track-following operation under one or more of a  
11                  first set of predetermined conditions, the control effort signal based on the distributed  
12                  position information, and for indicating the occurrence of a predetermined condition  
13                  within a second set of predetermined conditions to the control system;  
14              a second sampled servo controller, separate from the accelerator circuit, for  
15                  periodically adjusting the control effort signal based on the distributed position information  
16                  during a track-following operation under one or more of the second set of predetermined  
17                  conditions.

1        14. A magnetic disk drive as defined in claim 13, wherein  
2              the control system further includes a disk controller for controlling disk  
3              operations and a host interface for coupling the disk controller with a host system; and  
4              the second sampled servo controller, the disk controller and the host interface are  
5              implemented by a microprocessor that is separate from the accelerator circuit.

1        15. A magnetic disk drive as defined in claim 13, wherein the second sampled servo  
2 controller is implemented by the microprocessor using firmware code.

1        16. A magnetic disk drive as defined in claim 13, wherein the accelerator circuit has a  
2 plurality of multipliers that may simultaneously perform parallel calculations.

1        17. A magnetic disk drive as defined in claim 13 wherein the first set of  
2 predetermined conditions includes track following within a write unsafe limit.

1        18. A magnetic disk drive as defined in claim 13 wherein the second set of  
2 predetermined conditions includes track following outside of a write unsafe limit.

1        19. A magnetic disk drive as defined in claim 13, wherein, after receiving distributed  
2 position information in a servo wedge, the first sampled servo controller can adjust the control  
3 effort signal after a first processing delay and the second sampled servo controller can adjust the  
4 control effort signal after a second processing delay, wherein the first processing delay is less  
5 than the second processing delay.

1        20. A magnetic disk drive as defined in claim 19, wherein the first processing delay is  
2 less than one-tenth of the second processing delay.

1        21. A magnetic disk drive as defined in claim 19, wherein the first processing delay is  
2 less than one-fourth of the second processing delay.

1        22. A magnetic disk drive, comprising:  
2              a head disk assembly (HDA) including  
3                  a rotating magnetic disk having distributed position information in a  
4                  plurality of uniformly spaced-apart servo wedges for defining data storage tracks,  
5                  an actuator for positioning a transducer head in response to a control effort  
6                  signal, the transducer head for periodically reading the distributed position information  
7                  from the servo wedges and reading data from the data storage tracks; and  
8              a control system having  
9                  an accelerator circuit for implementing a first sampled servo controller for  
10                 periodically adjusting, only during a track-following operation under one or more of a  
11                 first set of predetermined conditions, the control effort signal based on the distributed  
12                 position information with a first processing delay;  
13              a microprocessor, separate from the accelerator circuit, for implementing a  
14                 second sampled servo controller using firmware code for periodically adjusting the  
15                 control effort signal based on the distributed position information, with a second  
16                 processing delay that is substantially greater than the first processing delay, during an  
17                 operation under one or more of a second set of predetermined conditions;  
18              wherein the control system selects the first sampled servo controller for adjusting  
19                 the control effort signal during a track-following operation under one or more of a first set of  
20                 predetermined conditions, and selects the second sampled servo controller for adjusting the  
21                 control effort signal during an operation under one or more of a second set of predetermined  
22                 conditions.

1        23. A magnetic disk drive as defined in claim 22, wherein the first processing delay is  
2              less than one-tenth of the second processing delay.

1        24. A magnetic disk drive as defined in claim 22, wherein the first processing delay is  
2              less than one-fourth of the second processing delay.

1        25. A magnetic disk drive as defined in claim 22, wherein  
2                  the control system further includes a disk controller for controlling disk  
3 operations and a host interface for coupling the disk controller with a host system; and  
4                  the second sampled servo controller, the disk controller and the host interface are  
5 implemented by a microprocessor that is separate from the accelerator circuit.

1        26. A magnetic disk drive as defined in claim 22, wherein the second sampled servo  
2 controller is implemented by the microprocessor using firmware code.

1        27. A magnetic disk drive as defined in claim 22, wherein the accelerator circuit has a  
2 plurality of multipliers that may simultaneously perform parallel calculations.

1        28. A magnetic disk drive as defined in claim 22 wherein the first set of  
2 predetermined conditions includes track following within a write unsafe limit.

1        29. A magnetic disk drive as defined in claim 22 wherein the second set of  
2 predetermined conditions includes track following outside of a write unsafe limit.